



## Sidewall Sampler for Characterizing Tank Farm Vadose Zone

### *The Challenge*

Historical waste leaks from the Hanford Single-Shell Tanks (SSTs) have resulted in radiological contamination of the underlying sediments in the vadose zone. Quantitative and qualitative data are required to understand the potential mechanisms, locations, and quantity of contamination in the vadose zone to support decisions regarding SST retrieval and tank farm closure. These sediments have not been fully characterized due to the potentially high radiation fields and dose rates associated with handling these materials. An efficient and lower cost means is needed to physically sample the vadose zone and characterize this hazardous environment.

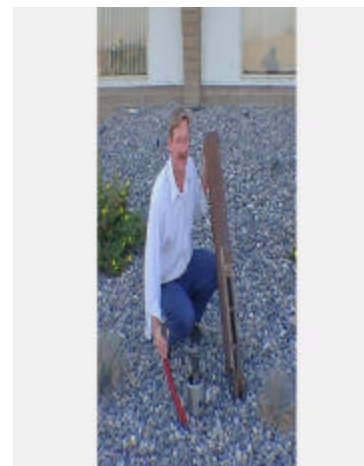
### *Current Approach*

Vadose zone sediment samples are obtained by either drilling or driving a borehole to a predetermined depth and then deploying a sampling device to sample the sediments ahead of (below) the advancing borehole casing.

During the drilling process either continuous sampling is employed or sample locations are selected prior to the start of drilling. Extensive procedures are used to contain and control the sampling activities. Continuous sampling results in excellent geologic control and full capability to monitor small, but potentially important aspects of contaminant distribution. Continuous sampling does, however, subject workers to potentially harmful radiation exposure due to the physical size of the sampler needed to penetrate the Hanford sediments. Sampling in this manner is a high cost approach. Sampling at predetermined locations introduces a significant risk of missing those portions of the vadose zone that would yield the most valuable and useful information. Drilling of new wells is costly, results in generation of large quantities of waste and provides an additional pathway for contaminants to move.

### *New Technology*

Two sidewall-sampling systems, a primary and a backup sampler, were developed to collect small diameter (low dose-rate) samples from the sidewall of boreholes as the bores are decommissioned. As a borehole is being decommissioned, the casing is removed while filling the resulting void with bentonite (a naturally occurring clay material) or cement to seal the borehole and prevent future movement of contaminated water down the bore. Sampling locations are selected based on gross or spectral gamma geophysical logs of the borehole.



In the person's right hand is the sidewall rotary coring (primary) sampler and in his left hand, the spring-loaded arm sampler (backup).

### *Benefits and Features*

- ◆ Supports As-Low-As-Reasonably-Achievable (ALARA) objectives
- ◆ Enables program to collect and analyze sediments from specific, targeted zones
- ◆ Reduces waste generation
- ◆ Provides opportunity to significantly reduce programmatic costs
- ◆ Supports risk assessments

The sidewall samplers are both actuated using a drilling machine. The first system is deployed using a rotary coring device and downhole deflector. The second system uses a spring-loaded arm to deploy the sampler, which is driven into the formation as the drill rods are extracted.

For the first system a television survey is again utilized to inspect the borehole to a depth below the casing. This allows the pointed sampler to swing out to contact the borehole wall at a shallow angle. The downhole deflector is then carefully set into position (vertical and azimuth orientation). The sampler is then lowered into the downhole deflector, rotated and advanced into the surrounding formation. The sampler can be advanced into the formation about 20 cm, cutting a core as it advances. The sampler is then disconnected from the drill rod and deployment device and sent to the laboratory for analysis. Only limited success was attained using this sampler; engineering design changes are underway. This design is projected to be useful in fulfilling future tank farm sampling needs because of the ability to precisely locate and direct this sampler and the rotational method used to gather the sample.

For the second system the sampler is lowered into the borehole to the backfill. A trip is actuated when a foot on the sampler contacts the bentonite backfill causing the sampler to swing outwards contacting the borehole wall at a shallow angle. As the drill rod is raised the sampler is driven into the formation, capturing a 1.25-in. to 4-in. square sample. As the drill rod continues to be lifted, the sample tube is pulled from the formation and drops parallel to the drill rod. The sampler is removed from the borehole, disconnected from the drill rod and sent to the laboratory for analysis of its contents. The simplicity of this sampler allows for efficient operation. This system successfully and safely retrieved vadose zone samples with a

contact radiation dose of greater than 3 R/hour. However, this sampler cannot be located in the borehole as precisely as the rotary core sampler, and the entry orientation of this sampler itself is not as precisely controlled.

Both sidewall samplers have been deployed in the 241-SX Tank Farm to collect samples from a borehole that has exhibited the deepest movement of cesium-137 found to-date. Samples derived from this effort are being analyzed to determine the geochemical nature of this deep movement and to determine if other, more mobile contaminants such as technetium-99 have moved ahead of the cesium-137. Sampling and analysis of the highly contaminated zone will yield previously unknown information on the geochemical interactions between the sediments and the hot, highly caustic tank wastes. This sampling technology will provide reduced cost vadose zone data for tank farms.

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